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Suttle Lake
Jefferson County, Oregon

National Eutrophication Survey, Corvallis, Oreg

Prepared for

Corvallis Environmental Research Lab, Oreg

Jan 78

PB 281 870

U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

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and

ENVIRONMENTAL MONITORING & SUPPORT LABORATORY - LAS VEGAS, NEVADA

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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REPORT
ON
SUTTLE LAKE
JEFFERSON COUNTY
OREGON
EPA REGION X
WORKING PAPER No. 833

WITH THE COOPERATION OF THE
OREGON DEPARTMENT OF ENVIRONMENTAL REGULATION
AND THE
OREGON NATIONAL GUARD
JANUARY, 1978

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Oregon Department of Environmental Quality for the professional involvement and to the Oregon National Guard for conducting the tributary sampling phase of the the Survey.

William H. Young, Department Director, and Harold L. Sawyer, Administrator, and the staff of the Water Quality Control Division provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

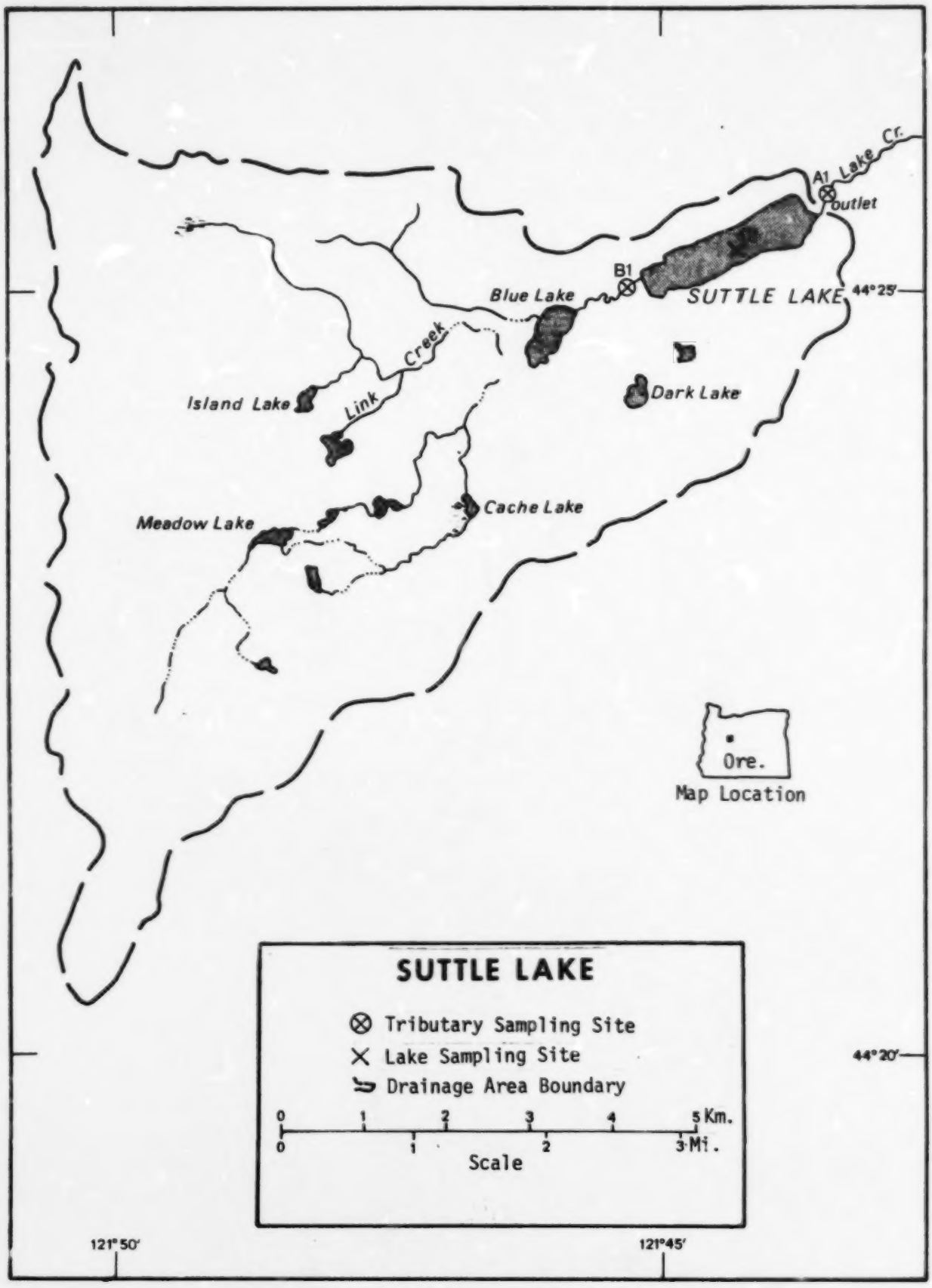
Brigadier General Richard A. Miller, the Adjutant General of Oregon, and Project Officer Lt. Colonel John Mewha, who directed the volunteer efforts of the Oregon National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES and RESERVOIRS

STATE OF OREGON

NAME	COUNTY
Brownlee	Baker, OR; Washington, ID
Diamond	Douglas
Hells Canyon	Baker, Wallowa, OR; Adams, Idaho, ID
Hills Creek	Lane
Owyhee	Malhuer
Oxbow	Baker, OR; Adams, ID
Suttle	Jefferson
Waldo	Lane


A1
Lake Cr.
outlet
B1
Blue Lake
SUTTLE LAKE
44°25'
Link Creek
Island Lake
Dark Lake
Meadow Lake
Cache Lake
Ore.
Map Location
SUTTLE LAKE
Tributary Sampling Site
Lake Sampling Site
Drainage Area Boundary
0 1 2 3 4 5 Km.
0 1 2 3 Mi.
Scale
44°20'
121°50'
121°45'

SUTTLE LAKE

STORET NO. 4107

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Suttle Lake is meso-eutrophic. It ranked third in overall trophic quality when the eight Oregon lakes and reservoirs sampled in 1975 were compared using a combination of six parameters*. Two of the water bodies had less median total phosphorus, two had less median dissolved orthophosphorus, none had less and two had the same median inorganic nitrogen, four had less mean chlorophyll a, and two had greater mean Secchi disc transparency. Significant depression of dissolved oxygen with depth did not occur at any sampling time.

B. Rate-Limiting Nutrient:

The results of the algal assay indicate that nitrogen was the limiting nutrient when the assay sample was taken (03/28/75).

The lake data indicate nitrogen limitation all three sampling times.

C. Nutrient Controllability:

1. Point sources--No known municipal or industrial point sources impacted Suttle Lake during the sampling year. It is estimated that septic tanks serving lakeshore dwellings and campgrounds contributed 0.5% of the total phosphorus load

* See Appendix A.

during the sampling year, but a shoreline survey would be necessary to determine the significance of those sources.

The present loading of 1.70 $g/m^2/yr$ is greater than that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic load (see page 11). Because of this, all phosphorus inputs to the drainage area of Suttle Lake should be reduced as much as possible to slow the aging of the lake.

2. Non-point sources--Non-point sources, including direct precipitation, contributed 99.5% of the total phosphorus load to Suttle Lake during the sampling year. The Blue Lake outlet stream added 81.9% of the total, and the ungaged tributaries added an estimated 16.5%.

The non-point phosphorus export rate of the Blue Lake outlet stream was 32 $kg/km^2/yr$ (see page 10).

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Morphometry††:

1. Surface area: 1.09 kilometers^2.
2. Mean depth: 9.9 meters.
3. Maximum depth: 21.0 meters.
4. Volume: 10.791 x 10^6 m^3.
5. Mean hydraulic retention time: 87 days.

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Blue Lake outlet	46.9	1.350
Minor tributaries & immediate drainage -	9.5	0.097
Totals	56.4	1.447

2. Outlet -

Lake Creek	57.5**	1.440

C. Precipitation***:

1. Year of sampling: 30.9 centimeters.
2. Mean annual: 30.8 centimeters.

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† Table of metric equivalents--Appendix B.
†† Newcomb, 1941.
* For limits of accuracy, see Working Paper No. 175, "... Survey Methods, 1973-1976".
** Includes area of lake.
*** See Working Paper No. 175.

III. WATER QUALITY SUMMARY

Suttle Lake was sampled three times during the open-water season of 1974 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from a number of depths at one station on the lake (see map, page v). During each visit, a single depth-integrated (4.6 m to surface) sample was collected for phytoplankton identification and enumeration; and a similar sample was collected for chlorophyll a analysis. During the first visit, a single 18.9-liter depth-integrated sample was taken for algal assays. The maximum depth sampled was 18.9 meters.

The sampling results are presented in full in Appendix D and are summarized in the following table.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR SUTTLE LAKE
STORET CODE 4107

PARAMETER	1ST SAMPLING (3/28/75) 1 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (7/16/75) 1 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (10/31/75) 1 SITES RANGE	MEAN	MEDIAN
TEMP (C)	2.7 - 3.5	3.4	3.5	11.1 - 16.8	14.7	16.6	9.7 - 10.2	10.0	10.1
DISS OXY (MG/L)	11.4 - 11.8	11.7	11.7	8.2 - 10.0	9.5	10.0	8.8 - 9.0	8.8	8.8
CNDCTVY (MCROMO)	50. - 52.	50.	50.	37. - 47.	42.	44.	46. - 57.	49.	47.
PH (STAND UNITS)	7.5 - 7.6	7.5	7.5	7.3 - 9.2	8.5	9.1	7.3 - 7.4	7.3	7.3
TOT ALK (MG/L)	26. - 30.	28.	27.	25. - 28.	26.	26.	36. - 38.	37.	38.
TOT P (MG/L)	0.021 - 0.098	0.035	0.023	0.021 - 0.100	0.042	0.031	0.046 - 0.111	0.063	0.048
ORTHO P (MG/L)	0.014 - 0.028	0.021	0.021	0.007 - 0.041	0.019	0.014	0.013 - 0.025	0.016	0.014
NO2+NO3 (MG/L)	0.020 - 0.020	0.020	0.020	0.020 - 0.030	0.022	0.020	0.020 - 0.020	0.020	0.020
AMMONIA (MG/L)	0.020 - 0.030	0.022	0.020	0.030 - 0.040	0.034	0.030	0.020 - 0.020	0.020	0.020
KJEL N (MG/L)	0.200 - 0.300	0.217	0.200	0.200 - 0.600	0.480	0.500	0.200 - 0.200	0.200	0.200
INORG N (MG/L)	0.040 - 0.050	0.042	0.040	0.050 - 0.060	0.056	0.060	0.040 - 0.040	0.040	0.040
TOTAL N (MG/L)	0.220 - 0.320	0.237	0.220	0.230 - 0.620	0.502	0.520	0.220 - 0.220	0.220	0.220
CHLRPYL A (UG/L)	1.2 - 1.2	1.2	1.2	24.9 - 24.9	24.9	24.9	1.4 - 1.4	1.4	1.4
SECCHI (METERS)	-			1.8 - 1.8	1.8	1.8	3.7 - 3.7	3.7	3.7

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
03/28/75	1. Melosira sp.	1,374
	2. Dactylococcopsis sp.	153
	3. Synedra sp.	38
	Total	1,565
07/16/75	1. Anabaena sp.	1,263
	2. Asterionella sp.	90
	Total	1,353
10/31/75	1. Stephanodiscus sp.	637
	2. Fragilaria sp.	495
	3. Chroomonas (?) sp.	283
	4. Cryptomonas sp.	106
	5. Asterionella sp.	35
	Other genera	142
	Total	1,698

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
03/28/75	1	1.2
07/16/75	1	24.9
10/31/75	1	1.4

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.018	0.012	0.4
0.050 P	0.068	0.012	0.4
0.050 P + 1.0 N	0.068	1.012	17.8
1.0 N	0.018	1.012	5.8

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential primary productivity of Suttle Lake was moderate at the time the sample was taken (03/28/75). The addition of nitrogen alone produced a significant increase in yield, but no such increase occurred with the addition of only phosphorus. Therefore, limitation by nitrogen is indicated.

The lake data indicate nitrogen limitation all three sampling times; i.e., the mean inorganic nitrogen to orthophosphorus ratios were 2 to 1 in March, 3 to 1 in July, and 3 to 1 in October.

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Oregon National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v). Sampling was begun in October, 1974, and was completed in September, 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Oregon District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the nutrient loads at station B-1, in kg/km^2/year, and multiplying by the ZZ area in km^2.

No known wastewater treatment plants impacted Suttle Lake during the sampling year.

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* See Working Paper No. 175.

A. Waste Sources:

1. Known municipal - None

2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/yr	% of total
a. Tributaries (non-point load) -		
Blue Lake outlet	1,520	81.9
b. Minor tributaries & immediate drainage (non-point load) -	305	16.5
c. Known municipal STP's - None	-	-
d. Septic tanks* -	10	0.5
e. Known industrial - None	-	-
f. Direct precipitation** -	20	1.1
Total	1,855	100.0

2. Outputs -

Lake outlet - Lake Creek 1,355

3. Net annual P accumulation - 500 kg.

* Estimate based on six lakeshore dwellings and four campgrounds; see Working Paper No. 175.

** See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (non-point load) -		
Blue Lake outlet	14,670	76.6
b. Minor tributaries & immediate drainage (non-point load) -	2,975	15.5
c. Known municipal STP's - None	-	-
d. Septic tanks* -	345	1.8
e. Known industrial - None	-	-
f. Direct precipitation** -	1,175	6.1
Total	19,165	100.0

2. Outputs -

Lake outlet - Lake Creek 29,445

3. Net annual N loss - 10,280 kg.

D. Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km^2/yr	kg N/km^2/yr
Blue Lake outlet	32	313

* Estimate based on six lakeshore dwellings and four campgrounds; see Working Paper No. 175.
** See Working Paper No. 175.

E. Yearly Loads:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m^2/yr	1.70	0.46	17.6	loss*

Vollenweider phosphorus loadings ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Suttle Lake:	
"Dangerous" (eutrophic loading)	1.24
"Permissible" (oligotrophic loading)	0.62

* There was an apparent loss of nitrogen during the sampling year. This may have been due to nitrogen fixation in the lake, solubilization of previously sedimented nitrogen, recharge with nitrogen-rich ground water, unsampled point sources discharging directly to the lake, or (probably) insufficient outlet sampling in relation to the relatively short hydraulic retention time of the lake. Whatever the cause, a similar nitrogen loss has occurred at Shagawa Lake, Minnesota, which has been intensively studied by EPA's former National Eutrophication and Lake Restoration Branch (Malueg et al., 1975).

V. LITERATURE REVIEWED

Malueg, Kenneth W., D. Phillips Larsen, Donald W. Schults, and Howard T. Mercier; 1975. A six-year water, phosphorus, and nitrogen budget for Shagawa Lake, Minnesota. Jour. Environ. Qual., vol. 4, no. 2, pp. 236-242.

Newcombe, Hugh R., 1941. A biological investigation of forty lakes of the upper Deschutes River watershed in Oregon. Lake Survey Rept. No. 1. OR Game Comm., Portland.

Vollenweider, R. A., and P. J. Dillon, 1974. The application of the phosphorus loading concept to eutrophication research. Natl. Res. Council of Canada Publ. No. 13690, Canada Centre for Inland Waters, Burlington, Ontario.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
4101	BROWNLEE RESERVOIR	0.079	0.560	428.133	16.207	14.500	0.043
4102	DIAMOND LAKE	0.028	0.040	294.500	7.300	6.800	0.011
4103	HELLS CANYON RESERVOIR	0.068	0.640	429.111	18.722	12.400	0.045
4104	HILLS CREEK RESERVOIR	0.038	0.060	435.200	2.333	7.400	0.027
4105	OWYHEE	0.095	0.425	480.417	3.350	13.200	0.064
4106	OXBOW RESERVOIR	0.071	0.690	425.555	10.311	12.200	0.040
4107	SUTTLE LAKE	0.031	0.040	95.000	9.167	6.800	0.020
4108	WALDO LAKE	0.005	0.040	-100.000	0.350	6.800	0.006

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDE NO
4101	BROWNLEE RESERVOIR	14 (1)	29 (2)	43 (3)	14 (1)	0 (0)	29 (2)	129
4102	DIAMOND LAKE	86 (6)	93 (6)	71 (5)	57 (4)	86 (5)	86 (6)	479
4103	HELLS CANYON RESERVOIR	43 (3)	14 (1)	29 (2)	0 (0)	29 (2)	14 (1)	129
4104	HILLS CREEK RESERVOIR	57 (4)	57 (4)	14 (1)	86 (6)	57 (4)	57 (4)	328
4105	OWYHEE	0 (0)	43 (3)	0 (0)	71 (5)	14 (1)	0 (0)	128
4106	OXBOW RESERVOIR	29 (2)	0 (0)	57 (4)	29 (2)	43 (3)	43 (3)	201
4107	SUTTLE LAKE	71 (5)	71 (5)	86 (6)	43 (3)	86 (5)	71 (5)	428
4108	WALDO LAKE	100 (7)	93 (6)	100 (7)	100 (7)	86 (5)	100 (7)	579

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	4108	WALDO LAKE	579
2	4102	DIAMOND LAKE	479
3	4107	SUTTLE LAKE	428
4	4104	HILLS CREEK RESERVOIR	328
5	4106	OXBOW RESERVOIR	201
6	4101	BROWNLEE RESERVOIR	129
7	4103	HELLS CANYON RESERVOIR	129
8	4105	OWYHEE	128

APPENDIX B

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

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APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR OREGON 08/11/76

LAKE CODE 4107 SUTTLE LAKE

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 57.5

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
4107A1	57.5	1.68	1.70	1.50	1.78	2.27	1.90	1.10	0.90	0.87	0.93	1.16	1.58	1.44
4107B1	46.9	1.56	1.59	1.39	1.64	2.10	1.76	1.05	0.85	0.82	0.88	1.10	1.47	1.35
4107Z2	10.6	0.097	0.097	0.097	0.097	0.097	0.097	0.097	0.097	0.097	0.097	0.097	0.097	0.097

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 57.5
SUM OF SUB-DRAINAGE AREAS = 57.5
TOTAL FLOW IN = 17.36
TOTAL FLOW OUT = 17.36

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
4107A1	10	74	1.019	19	1.076				
	11	74	1.189	22	1.189				
	12	74	1.671	14	1.416				
	1	75	2.549	4	2.067	17	2.010		
	2	75	2.435	9	2.350	21	2.350		
	3	75	2.180	9	2.379				
	4	75	1.586	14	1.501				
	5	75	2.605	18	3.115				
	6	75	2.549	18	2.294				
	7	75	1.359	20	1.274				
	8	75	1.133	9	1.104	10	1.161		
	9	75	1.048	13	1.048				
4107B1	10	74	0.963	19	0.963				
	11	74	1.104	22	1.104				
	12	74	1.557	14	1.331				
	1	75	2.350	4	1.897	17	1.841		
	2	75	2.265	9	2.152	21	2.152		
	3	75	2.010	9	2.180				
	4	75	1.472	14	1.388				
	5	75	2.379	18	2.832				
	6	75	2.350	18	2.095				
	7	75	1.274	20	1.189				
	8	75	1.076	10	1.104				
	9	75	0.991	13	0.991				

TRIBUTARY FLOW DATA ARMORY

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 75/08/12

410701
44 25 20.0 121 44 20.0 3
SUTTLE LAKE
41031 OREGON

131091

11EPALES 2111202
0067 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/03/28	11 20	0000	2.7	11.6		52	7.50	27	0.020	0.200K	0.020K	0.024
	11 20	0005	3.5	11.6		50	7.60	27	0.020K	0.200K	0.020K	0.020
	11 20	0015	3.5	11.8		50	7.60	27	0.020	0.200K	0.020K	0.021
	11 20	0030	3.5	11.8		51	7.50	26	0.020K	0.200K	0.020K	0.022
	11 20	0045	3.5	11.8		50	7.50	28	0.020K	0.200K	0.020K	0.014
	11 20	0061	3.5	11.4		50	7.50	30	0.030	0.300	0.020K	0.028
75/07/16	15 30	0000	16.8	10.0	72	46	9.10	26	0.040	0.600	0.020K	0.013
	15 30	0005	16.8	10.0		44	9.20	28	0.030	0.500	0.020K	0.014
	15 30	0015	16.6	10.0		47	9.10	27	0.030	0.500	0.020K	0.007
	15 30	0035	12.2	8.2		38	7.80	25	0.030	0.200	<0.030	0.020
	15 30	0062	11.1			37	7.30	26	0.040	0.600	0.020K	0.041
75/10/31	10 15	0000	10.2	9.0	144	57	7.30	37	0.020K	0.200K	0.020K	0.013
	10 15	0005	10.2	8.8		47	7.40	38	0.020K	0.200	0.020K	0.014
	10 15	0030	10.1	8.8		46	7.30	38	0.020K	0.200	0.020K	0.025
	10 15	0061	9.7	8.8		46	7.30	36	0.020K	0.200	0.020K	0.014

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/03/28	11 20	0000	0.024	1.2	
	11 20	0005	0.021		
	11 20	0015	0.021		
	11 20	0030	0.022		
	11 20	0045	0.027		
	11 20	0061	0.098		
75/07/16	15 30	0000	0.031	24.9	
	15 30	0005	0.027		
	15 30	0015	0.033		
	15 30	0035	0.021		
	15 30	0062	0.100		
75/10/31	10 15	0000	0.046	1.4	
	10 15	0005	0.047		
	10 15	0030	0.049		
	10 15	0061	0.111		

K VALUE KNOWN TO BE

APPENDIX E

TRIBUTARY DATA

STORET RETRIEVAL DATE 76/08/12

4107A1
44 25 35.0 121 43 30.0 4
LAKE CREEK
41 15 SISTERS
0/SUTTLE LAKE 131091
SANTIAM HWY BRDG 13.5 MI NE OF SISTERS
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/10/19	10 30		0.016	0.200	0.025	0.015	0.040
74/11/22	09 45		0.008	0.600	0.030	0.015	0.020
74/12/14	10 25		0.008	0.200	0.007	0.010	0.040
75/01/04	14 00		0.008	0.900	0.010	0.017	0.030
75/01/17	14 20		0.008	0.200	0.016	0.008K	0.010
75/02/09	14 45		0.008	0.600	0.024	0.008	0.020
75/02/21	14 45		0.006	1.600	0.056	0.008	0.010
75/03/09	14 25		0.005	0.800	0.016	0.008	0.020
75/04/14	14 15		0.005	0.350	0.005K		0.010
75/05/18	13 00		0.025	0.350	0.020		0.030
75/06/18	13 45		0.020	0.300	0.010	0.015	0.030
75/07/20	14 10		0.005	0.600	0.015	0.010	0.040
75/08/09	19 00		0.145	0.850	0.015	0.015	0.090
75/08/10	12 55		0.020	0.450	0.045	0.010	0.020
75/09/13	13 30		0.020	1.600	0.015	0.005K	0.040

K VALUE KNOWN TO BE LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/12

410781
44 25 05.0 121 45 20.0 4
BLUE LAKE OUTLET
41 15 THR FNGRD JAC
T/SUTTLE LAKE 130992
SEC RD BRDG 15.5 MI NE OF SISTERS
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/10/19	09 50		0.024	0.175	0.175	0.035	0.040
74/11/22			0.016	0.100K	0.015	0.040	0.040
74/12/14	10 00		0.016	0.100K	0.005	0.040	0.040
75/01/04	13 40		0.003	0.500	0.020	0.035	0.050
75/01/17	14 00		0.008	0.300	0.008	0.032	0.032
75/02/09	14 30		0.008	0.700	0.016	0.016	0.030
75/02/21	14 00		0.008	0.100	0.012	0.016	0.016
75/03/09	14 10		0.012	1.000	0.012	0.016	0.020
75/04/14	14 30		0.005	0.875	0.005K	0.020	0.020
75/05/18	13 40		0.020	0.050K	0.010		0.030
75/06/18	13 00		0.010	0.400	0.005	0.015	0.022
75/07/20	14 30		0.005	0.075	0.020	0.025	0.030
75/08/10	12 40		0.020	0.050K	0.015	0.030	0.050
75/09/13	13 20		0.015	0.500	0.005K	0.035	0.050

K VALUE KNOWN TO BE
LESS THAN INDICATED